

Estonian is known for its three-way quantity distinction. The primary feature of Estonian quantity is the length of the first syllable nucleus in combination with the duration pattern of the sound segments in the foot (Lehiste 1997, 2003; Traummüller, Krull 2003; Eek, Meister 2003, 2004). It has been shown that besides the durational cues **pitch plays an important role in the Estonian quantity perception, being vital for distinguishing long from overlong quantity degree** (Lehiste 1970, 1997, 2003; Lehiste, Danforth 1977; Eek 1980). **The pitch contour of words in short (Q1) and long quantity degree (Q2) have the turning point at the end of the first syllable, while overlong quantity degree (Q3) has it earlier in the first syllable** (e.g. Lehiste 1997, 2003).

In Lippus et al. (2007) we reported the results of a group of 9 native vs. 9 near-native Estonian speakers (the latter with different first languages). The results of the Estonian speakers showed that in the case of vowel quantity, the test subjects failed to perceive Q3 if the pitch cue was that of Q1 or Q2, but distinguished between all the quantity degrees successfully if the consonant quantity was carried by a voiceless stop. The results of the near-native Estonian speakers showed that the various F0 contours had no effect and all the quantity levels were perceived with all the sets of stimuli. They differed in that their crossover points in all sets were not as clear as those of the Estonian listeners.

In this broader study we are taking a closer look at a larger group of Estonians with various regional backgrounds.

Stimuli

For re-synthesis, six words were read in a carrier sentence by male speaker:

- sada [sata] Q1 ‘hundred’,
 - saada [sa:ta] Q2 ‘send!’,
 - saada [sa::ta] Q3 ‘to get’
- } the main quantity distinction by V1
- kada [kata] Q1 ‘slingshot’,
 - kata [katta] Q2 ‘cover!’,
 - katta [kat:ta] Q3 ‘to cover’
- } the main quantity distinction by C2

Re-synthesis (in Praat):

- From each word a set of nine stimuli was created by manipulating the duration of either the first vowel or the intervocalic consonant.
- The stimuli were created so that for the first stimuli the syllable duration ratio would be <2:3 and for the last >2:1. (According to Lehiste, the syllable duration ratios for Q1, Q2 and Q3 are 2:3, 3:2 and 2:1 (see Lehiste 1997 for details).)
- Only the duration of one sound in the word was changed, starting from 50 ms in nine steps of 30 ms to 290 ms. The locations of the pitch turning points remained proportionally unchanged (original pitch curves Figure 1 and 2).
- The stimuli from each base word were arranged as a sub-test and were presented to the listeners with 10 repetitions in random order.

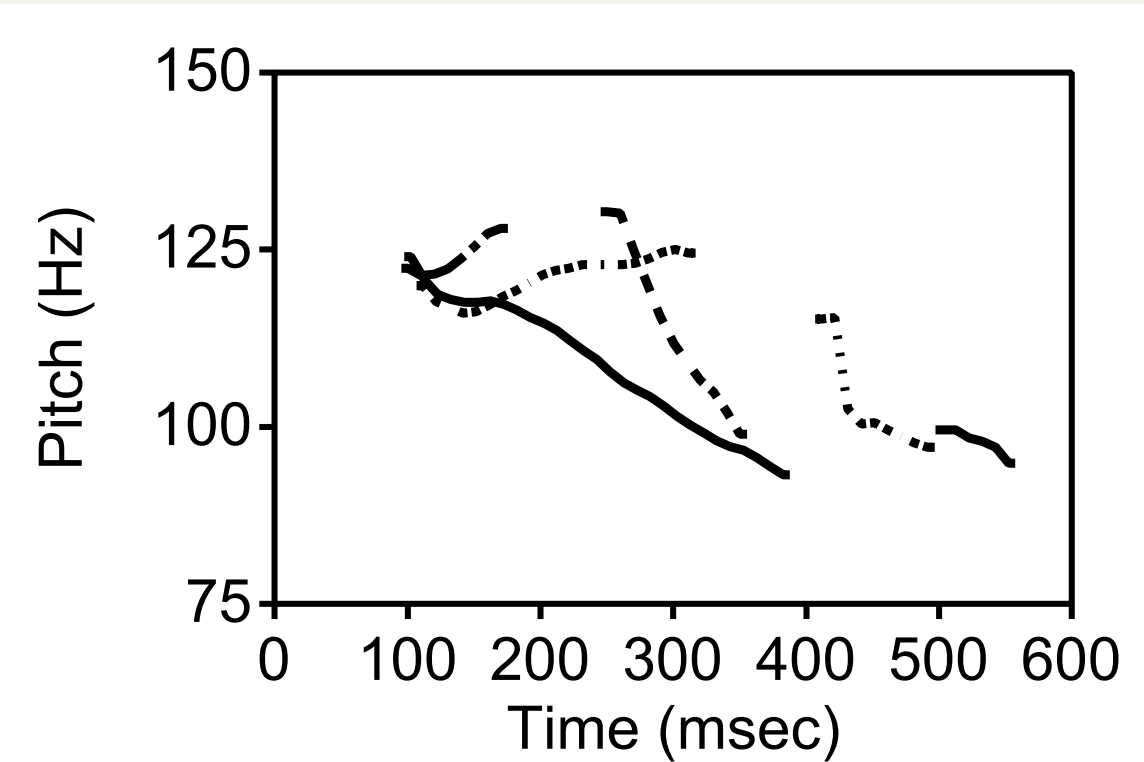


Figure 1: The pitch curves in the test words [sata] (Q1) dashed line, [sa:ta] (Q2) dotted line, [sa::ta] (Q3) solid line.

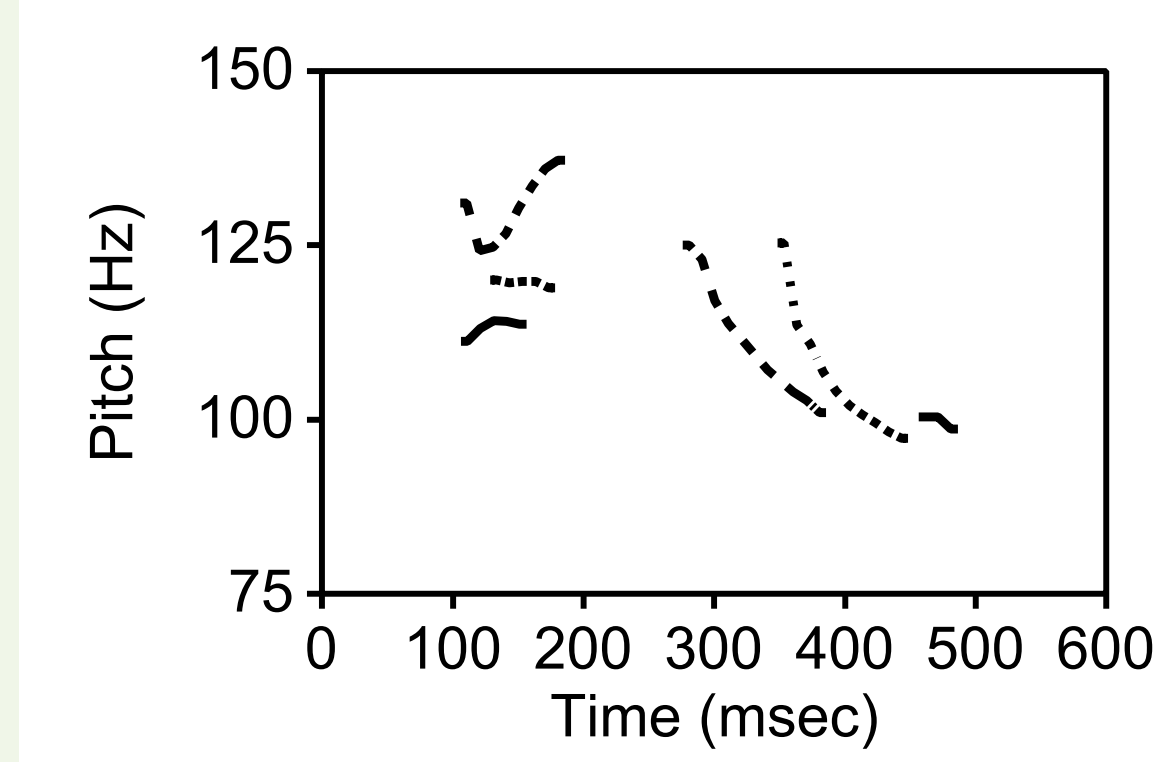


Figure 2: The pitch curves in the test words [kata] (Q1) dashed line, [katta] (Q2) dotted line, [kat:ta] (Q3) solid line.

Test procedure

- The test subjects were 35 students of the University of Tartu (9 male, 26 female; age 18-40 years).
- A forced-choice perception experiment was carried out in Praat.
- The subjects were instructed that they will hear synthesized words and have to decide, whether they heard a Q1 word, a Q2 word, or a Q3 word, and click a button on the computer screen, labeled [1], [2], and [3] accordingly.

Results

The results of the 35 subjects show two main groups. In case of vowel lengthening the first group (18 subjects) was strongly influenced by the pitch cue while the second group (17 subjects) was not. In case of consonant lengthening there was no difference between the two groups because the lengthened consonant was a voiceless stop and the pitch cue was missing.

In case of vowel lengthening:

- **Group 1** did not perceive Q3 in the sub-test 2, where the base word was [sa:ta] and the stimuli had the Q2 pitch contour even if the temporal structure was typical for a Q3 word (Figure 3, b).
- In **Group 1** the perception of Q3 was limited also in the sub-test 1, where the base word was [sata] and the stimuli had the Q1 pitch contour (Figure 3, a).
- In case of the sub-test 3, where the base word was [sa::ta] which had the Q3 pitch contour, the subjects in **Group 1** perceived all the quantity degrees according to the durational pattern of the stimuli (Figure 3, c).
- **Group 2** had no difficulty perceiving Q3 in any sub-test and perceived all the quantity degrees according to the durational pattern of the stimuli. (Fig. 3, d, e, f).

In case of consonant lengthening where F0 was interrupted by a voiceless stop, **both groups perceived all the quantity degrees according to the durational pattern of the stimuli** (Fig. 4). In sub-test 6, where the base word was a Q3 word [kat:ta] the temporal structure did not favor Q1 and Q2 responses apparently due to a rather short V2 (Fig 4c, f).

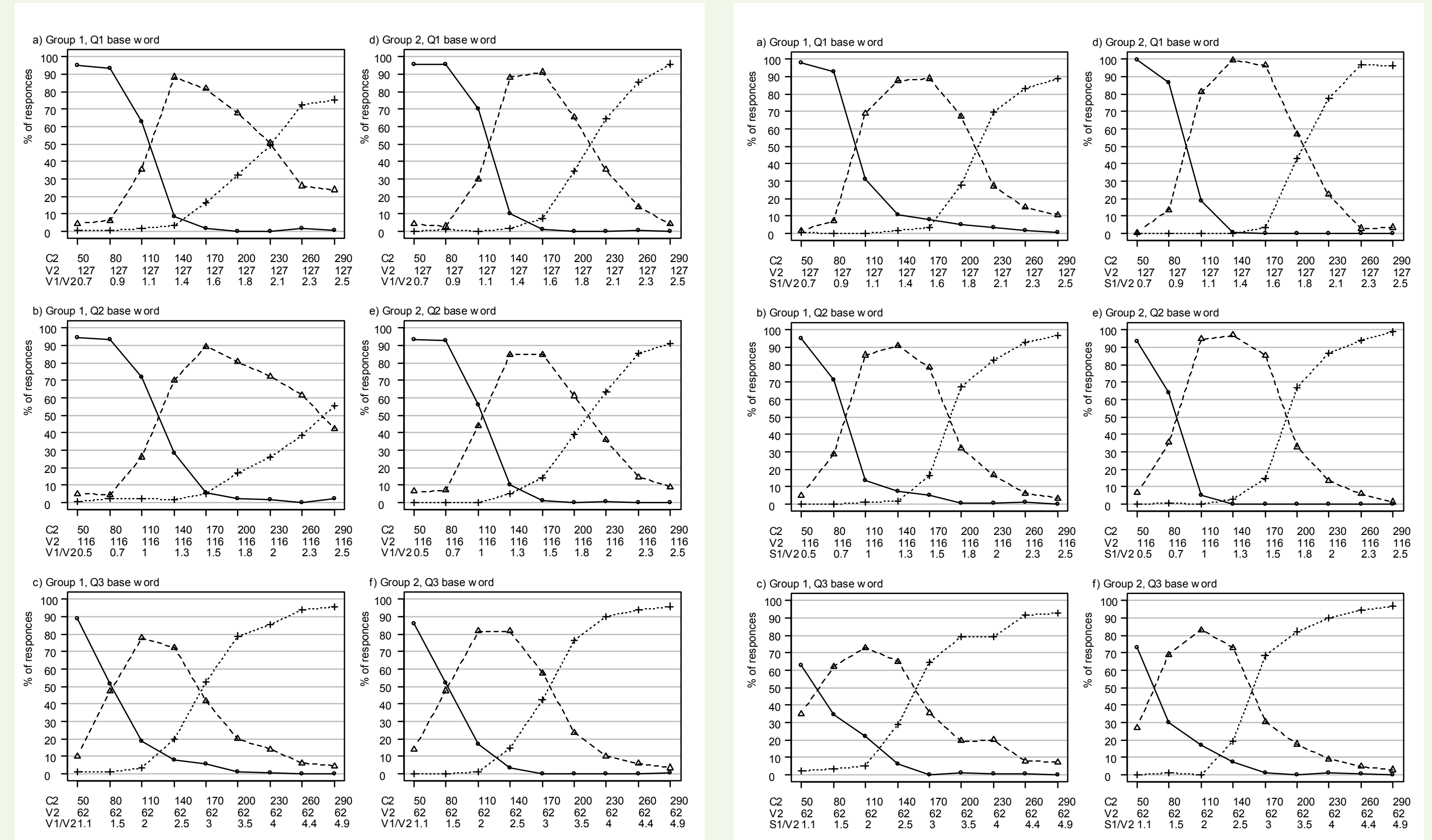


Figure 3. Results of the sub-tests where the base words [sata] (Q1), [sa:ta] (Q2) and [sa::ta] (Q3), V1 duration was manipulated. Q1 responses are presented with solid lines, Q2 responses with dashed lines and Q3 responses with dotted lines. Group 1 in the left column, Group 2 in the right column

Figure 4. Results of the sub-tests where the base words [kata] (Q1), [katta] (Q2), and [kat:ta] (Q3), C2 duration was manipulated. Q1 responses are presented with solid lines, Q2 responses with dashed lines and Q3 responses with dotted lines. Group 1 in the left column, Group 2 in the right column.

The two groups were tested for equality of proportions of different responses. The Pearson's chi-square test showed a significant difference in proportion of Q2 and Q3 responses between the Group 1 and Group 2 in sub-test 1 ($p < 0.01$) and sub-test 2 ($p < 0.001$). The responses to the other sub-tests showed no significant differences.

Discussion

The differences between the two groups tended to be based on the dialectal background of the subjects (see Figure 5):

- Among the subjects from western and central Estonian dialect areas, the majority (78%, 14/18) were strongly influenced by the F0 (belonging to the Group 1).
- The tonal effect was not so important for the subjects from eastern and southern Estonia (24%, 4/17; the majority belongs to the Group 2).
- The boundary between the two groups runs along the main borders of Estonian dialect areas.

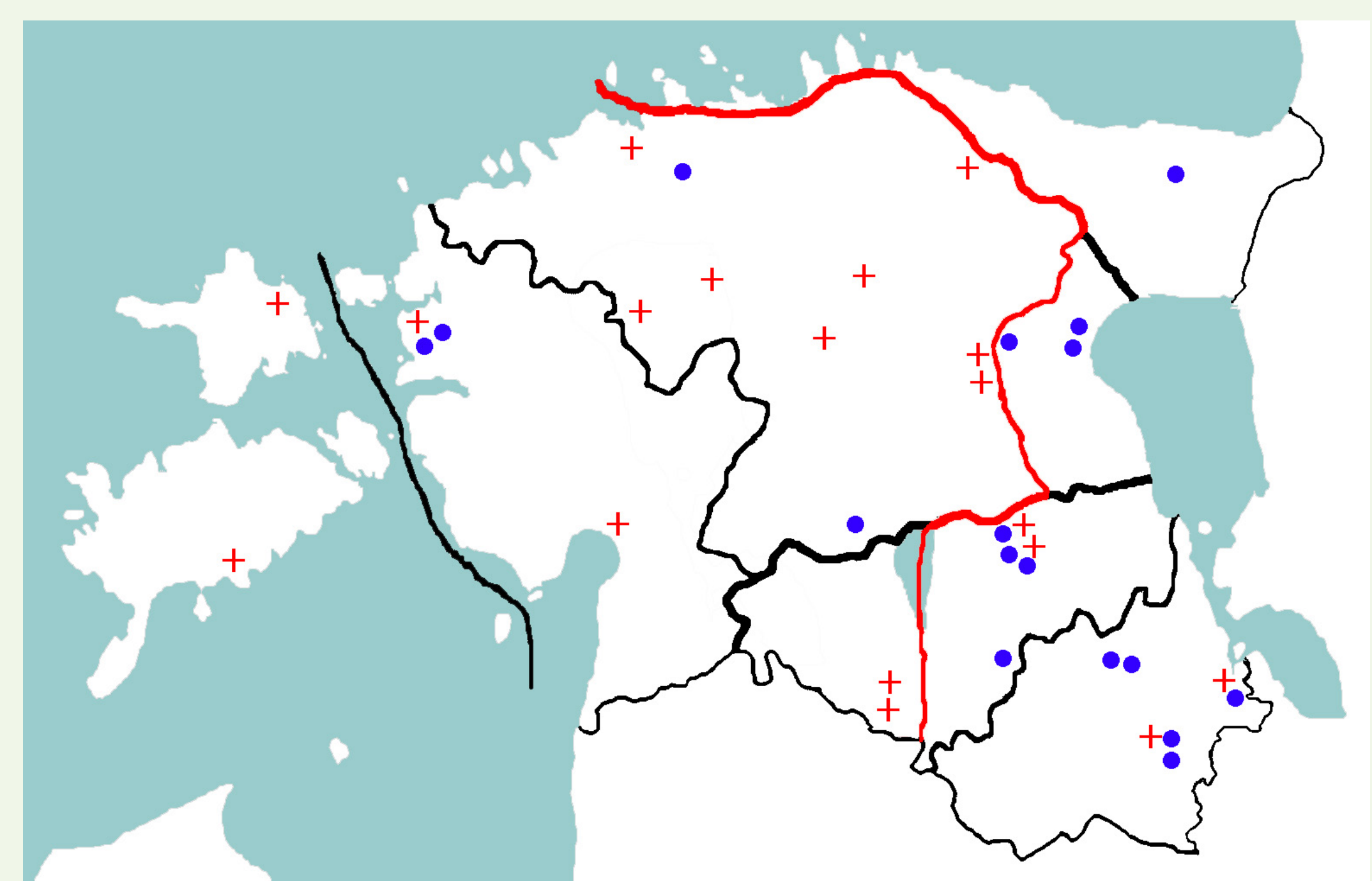


Figure 5. Regional background of the subjects on the map of Estonia showing the main dialect area borders. Group 1 is marked with red crosses, Group 2 with blue dots. Red line runs on the dialect area borders that could mark the boundary between the two groups.

These results indicate that language contacts could have influenced the differences in the perception of the word prosody of Estonian dialects: western parts of Estonia have had historic contacts with speakers of Baltic and Scandinavian languages (i.e. languages with tonal accents) while eastern parts of Estonia have had more historic contacts with Russians and northern coastal parts with Finns.

Conclusions

- There is some degree of regional variation in the perception Estonian quantity.
- Subjects from western and central Estonia need the pitch cue to discriminate between long (Q2) and overlong (Q3) quantities.
- Subjects from eastern and southern Estonia perceive the quantity degrees mainly on the basis of temporal cues.
- If the pitch cue is missing, the discrimination is based on temporal cues in both groups.

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